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# R-21/4K-55 - SS-N-5 SERB

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**DATA FOR 2024 (standard replenishment)**  
**Complex D-4, missile R-21 / 4K-55 - SS-N-5 SERB**  
**Complex D-4, missile R-21M / 4K-55M - SS-N-5 SERB**  
**★★★★**

Submarine-launched ballistic missile (SLBM). The development of a new SLBM with a sub-launch was started according to the Decree of the USSR Council of Ministers of March 20, 1958. The development of the missile was carried out by OKB-586 (now the Yuzhnoye Design Bureau) under the leadership of M.K. Yangel. At the same time, the same design bureau was developing the R-15 surface-launched missile. In addition, work was carried out at SKB-385 on the R-13M underwater launch rocket. After reviewing the results of these developments at NII-88 and the Navy institutes, a decision was made to complete work on these missiles. On December 3, 1958, a Resolution of the USSR Council of Ministers was issued to stop work on the R-15 rocket at OKB-586 and begin work on the development of the R-21 underwater launch rocket. The preliminary design of the R-21 missile was developed in collaboration with the design bureau, which worked on carrier submarines - SSBN pr.629 TsKB-16 (chief designer N.N. Isanin) and SSBN pr.658 (TsKB-18, chief designer S. N. Kovalev), as well as launchers (KB-1 TsKB-34, chief designer E. G. Rudyak).

In 1959, the country's leadership demanded the maximum acceleration of work on the creation of new missiles and, by the Resolution of the Council of Ministers of May 13, 1959, the ground-based missiles R-14 and R-16 were left behind OKB-586, and work on the creation of missiles for submarines was concentrated in SKB-385 V.P.Makeev. During the development process, the following cooperation between enterprises developed:

- the missile and the complex as a whole, the warhead - SKB-385 / GRTs im. Academician V.P.Makeev (Miass)
- launchers - TsKB-34 KB-1 (chief designer E.G. Rudyak)
- sustainer rocket engine - OKB-2 (chief designer - A.M. Isaev)
- thermonuclear ammunition - NII-1011 (now VNIITF)

Tests of the R-21 missile began in 1961 and were divided into three stages: throw tests of missile models from a stand and from an experimental submarine, then flight tests of the missiles.

For throw tests, a K1.1 mock-up was created, which was actually a prototype rocket with reduced volumes of fuel tanks. The first stage tests were carried out by launching the K1.1 prototype from a fixed floating stand PSD-4 from a depth of 40-50 meters. In the period from May 15 to July 22, 1961, 5 launches of K1.1 prototypes were carried out.

Tests by launching mock-ups from a submarine were carried out from the S-229 boat of Project 613-D4, converted into an experimental SSBN. A missile silo was installed behind the retractable device fence, which protruded from the boat's hull down 2 meters and up 6.8 meters. To accommodate the silos, part of the boat's living quarters and one group of batteries were dismantled. In the period from August 29 to September 11, 1961, three launches of K1.1 mock-ups were carried out from a depth of 40-50 meters at a boat speed of 2.6-3.5 knots.

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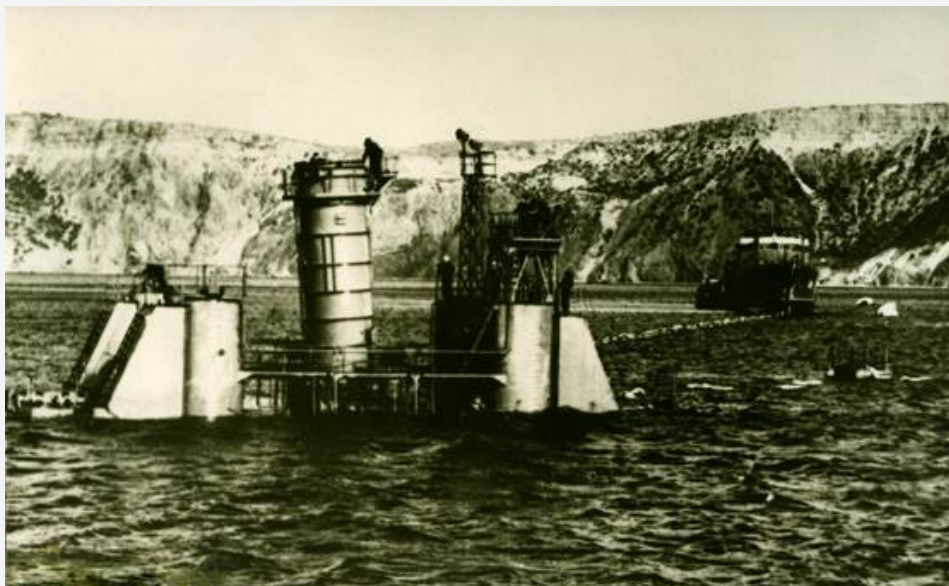
**R-21/4K-55 - SS-N-5 SERB**  

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R-21/4K-55 missile at the Museum of the USSR Armed Forces in Moscow (<https://missilery.info/>)



Stand PSD-4 ( <http://www.malachite-spb.ru/> )

Flight development tests of the missile were carried out by launching 4K-55 missiles from the submarine K-142 Project 629B (Project 629A-1 in some sources) starting in February 1962. The tests were carried out in the Northern Fleet and upon their completion on December 29, 1962. SSBN K-142

accepted by the Navy. On the boat pr.629, out of three silos for R-13 missiles, two silos were converted for launching R-21 missiles (SM-87 launchers with fixed launch pads were installed), and the third silo was not used. It was planned to test the D-6 complex SLBM with a solid-fuel missile from the same boat. The underwater launch was carried out from depths of 30-50 m from the level of the launch pad at a boat speed of 2-4 knots and sea waves up to 5 points. The first launch was carried out on February 24, 1962. In total, 15 missile launches were carried out during the flight test, of which 12 launches were successful.



Launch of the R-21 rocket ( <http://www.malachite-spb.ru/> )

Test launches of R-21 missiles :

	date	Status	Launch platform	Test site	Start type	
	05/15/1961 - 07/22/1961	throw launches of K1.1 prototypes	fixed floating stand PSD-4	Test site in Balaklava, Black Sea	underwater launches from a depth of 40-50 m	5 launches of K1.1 prototypes were completed
	08/29/1961 - 09/11/1961	throw launches from experimental SSBN	PLRB S-229 pr.613-D4	Test site in Balaklava, Black Sea	underwater launches from a depth of 40-50 m	3 launches of K1.1 prototypes were completed
01-15	02/24/1962	LKI with PLRB pr.629B	PLRB K-142 pr.629B	White Sea	underwater launches from a depth of 30-50 m of the LKI program	Successful launch. In total, 15 launches were carried out under the LKI program (including 12 successful ones)
16-28		Joint tests with SSBN pr.629A	SSBN pr.629A			12 successful launches of the joint testing program were completed
	12/14/1963	State tests	SSBN K-19 pr.658M	White Sea	Underwater launch	Successful launch as part of the SSBN testing program. Following the launch of the K-19 SSBN, it was accepted by the Navy on December 30, 1963.
	February 1966	LKI GC RA3G	SSBN K-19 pr.658M	White Sea	underwater launch on the Halmer-Yu field near Vorkuta	During the launch it was not possible to take all telemetry readings and the product needed to be modified
	second half of 1966 (?)	LKI GC RA3G	SSBN K-19 pr.658M	White Sea	underwater launch on the Halmer-Yu field near Vorkuta	Test launch with a modified RA3G product

Next, joint tests of the D-4 missile system with the SSBN Project 629A were carried out - 12 launches (all successful). The D-4 complex with the R-21 missile was adopted by Decree of the Council of Ministers of the USSR No. 539-191 of May 15, 1963.



Launch of the R-21 rocket ( <http://www.malachite-spb.ru/> )

The standard carrier of the R-21 SLBM was the SSBN pr.629A. The modernization of submarines from Project 629 to Project 629A was carried out according to the Decree of the USSR Council of Ministers dated July 2, 1962. The fleet allocated the first two boats only in 1964 and the lead SSBN K-88 underwent rework from August 30, 1964 to December 28, 1966 In total, 14 boats were converted (including K-142 pr.629B) - incl. 8 were modernized in the Northern Fleet at the Zvezdochka Shipyard and 6 in the Pacific Fleet - at the Shipyard named after. Lenin Komsomol. The re-equipment of SSBNs and their acceptance by the Navy was completed in 1972. In the Northern Fleet, Project 629A boats were part of the 16th division of the 12th submarine squadron, based in Olenya Bay. In September 1968, two boats left for the Pacific Ocean, and from 1971 to 1974, 4 more SSBNs. By the end of the 1970s, all SSBNs pr.629A of the Northern Fleet were transferred to the Baltic Fleet. In the late 1980s, under the SALT I treaty, the missile armament was dismantled, and the boats were taken out of service or converted into torpedo and experimental ships. By the end of 1989, the Navy still had 6 Project 629 SSBNs - 4 in the Baltic Fleet and 2 in the Pacific Fleet, but during 1990 all of them were withdrawn from service in the USSR Navy.

The second standard carrier is SSBN pr.658M. In 1963-1967 7 SSBNs (K-19, etc.) were converted to the D-4 complex with the R-21 missile. After entering the SSBN Project 667A Fleet, Project 658M boats were transferred to the 18th Division, which was transferred to Gremikha in the late 1970s. In accordance with the SALT-1 treaty, the removal of missile weapons from Project 658M submarines began in 1977. In 1979 this procedure was completed on the lead



boat. From 1983 to 1987, the removal of missile silos was carried out on the remaining boats of this project.

In the mid-1960s, the combat equipment of the R-21 missiles was modernized. The updated RA3G thermonuclear ammunition has been put into service.

In 1977-1979 the complex was modernized as part of work to extend its service life - the missile warhead was replaced with a new-generation unified warhead. The D-4 complex with the R-21M missile has been put into service (see Modifications below).

R-21 missiles were in service with the Navy from 1963 until the end of the 1980s. Over the entire period, 228 launches were completed (including 193 successful ones).

#### Launcher :

SM-87 - silo launcher with a launch pad for launching R-21 missiles from submarines developed by TsKB-34. The launch was carried out in the submerged position of the boat from a launch table with lever-spring depreciation, which was located on the lower edge of the launch shaft located in the hull and superstructure of the boat. When launched, the rocket moves along guides using yokes.

Type of launch - hot start on a propulsion engine made of water-filled PU

Type of shock absorption of the rocket - lever-spring

Pre-launch preparation - manual

Silo diameter - 2150 mm

Sea state during launch - up to 5 points

Launch depth - 30-50 m from the level of the launch pad

Preparation time for firing the first rocket - 30 minutes

Time for a full salvo of three rockets - 10 minutes



R-21/4K-55 missile in the SM-87 launcher (<https://missilery.info/>)

#### R-21 missile :

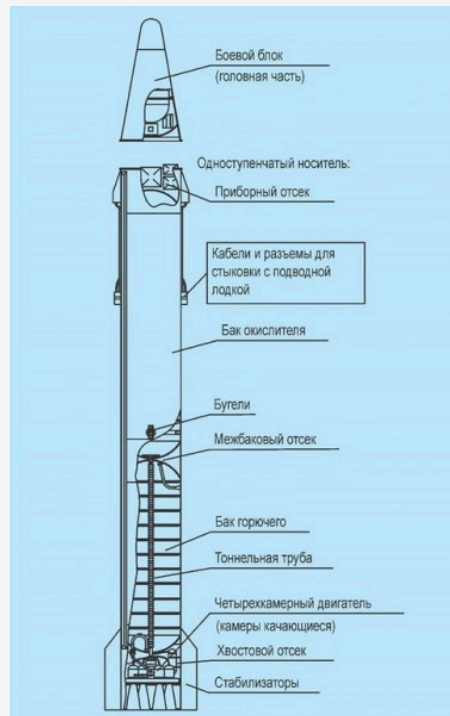
**Design** - a single-stage underwater launch ballistic missile with load-bearing tanks and a detachable warhead with a thermonuclear charge. The design of the rocket body is all-welded and consists of four sequentially located compartments: an instrument compartment, an oxidizer tank, a fuel tank and a tail compartment with stabilizers.

The connection between the control system equipment installed in the instrument compartment and the actuators (steering gear) is carried out by sealed cables coming out of the compartment through special sealed leads, the cavity of which is inflated with air from the so-called to ensure reliable tightness. "bells". Communication of the on-board control system equipment with the ship's test and launch equipment is carried out through two on-board special sealed connectors and replaceable cables.

The oxidizer and fuel tanks are designed to accommodate fuel components and are also the power body of the rocket. The tanks are separated by an intertank space, which communicates with the tail section through an annular gap between the tunnel and flow pipes. This made it possible to create excess pressure in the intertank cavity due to hydrostatic pressure at the rocket's exit and avoid weight gain. For the same purpose, the necessary back pressure of the external environment is ensured in the oxidizer and fuel tanks during pre-launch operations using preliminary and pre-launch pressurization systems.

To reduce overheating of the bow when passing through the atmospheric part of the trajectory, its toe had a rounded rather than pointed shape. The design and layout of the warhead was significantly changed compared to the previous product for the R-13 missile, and it already showed the features of promising warheads for domestic SLBMs, namely:

- the absence of joints on the outer surface of the body;
- placement of the main automatic components on the bottom, which could be opened without disconnecting the electrical connections of the detonation and charging automatics;
- the ability to carry out finishing operations through hatches on the bottom;
- implementation of the maximum possible reduction in weight and dimensions, including through the use of housing elements for fastening automation units.



Design of the R-21/4K-55 missile (<https://missilery.info/>)

The rocket control system is an autonomous inertial

**propulsion system:** LRE S5.3 developed by OKB-2 (chief designer - A.M. Isaev) four-chamber, with a central turbopump unit, "open circuit".

Fuel:

- oxidizer - AK-271 (27% solution of nitrogen oxides in nitric acid)
- fuel - TG-02 (Samin, Tonka-250)

Engine with automatic control of thrust and fuel component ratio. When developing the engine, much attention was paid to layout work in order to reduce the length compared to the R-13 rocket engine. As a result, with the same midsection, the engine had one and a half times more thrust and more than one and a half times less length. This was the first engine in which the control moments were created by the main rotary chambers, and not by special steering ones. The suspension units of the cameras allowed them to deviate by an angle of  $\pm 9^\circ$ . To ensure a rational relationship between the control moments for pitch, yaw and roll, the swing axes of the cameras are shifted relative to the stabilization planes by an angle of  $60^\circ$ .

The missiles were stored on the submarine in a fueled state. The shelf life of the missiles was 6 months, but later, based on the results of the operation of the complex and related research work, this period was extended to two years. The design of the engine, which does not require any checks and adjustments during operation, tightness from external pressure and a wide range of regulation ensured reliable starting of the engine under water and automatic maintenance of modes both in the underwater and above-water sections of the trajectory. The design of the engine provided for its shutdown during an emergency shutdown with hermetically sealed separation of the fuel lines.

#### Performance characteristics of the missile:

Length - 14.2 m  
Body diameter - 1.3 m  
Launch mass - 19,630 kg  
Throwing weight / warhead - 1,179 kg

Range - 1,420 km  
CEP - 2,800 m  
Trajectory parameters when firing at maximum range:  
Speed at the moment the engine is turned off - 3,439 m/s  
The height of the end of the active section is 68.9 km  
Flight time in the active phase - 93 s  
Total flight time to target - 384.6 s  
The speed of meeting the head with the target is 342 m/s  
Preparation time for firing the first rocket - 30 minutes  
Maximum overload at start - 3.7G  
Rocket travel time in the silo - 1.37 s  
Mine exit speed - 16.5 m/s  
Rocket exit time from water - 3.0 s  
The speed of the rocket exiting the water is 30.0 m/s.  
The rocket's guidance was ensured at launch up to 85 degrees north latitude

#### Combat equipment :

**D-4 / R-21** - monoblock detachable warhead RA3 / RA3G developed by NII-1011 (now VNIITF), chief designer A.D. Zakharenkov (later - L.F. Klopov). The head and charge housings are not combined. The resolution of the USSR Council of Ministers on the development of the R-21 missile warhead was issued on January 28, 1960. The thermonuclear charge "49" developed by KB-11 (now VNIIEF) is used, the leading designers are Yuri Trutnev and Yuri Babaev. Development of the warhead housing - SKB-385, development of the radio sensor - SKB-885, development of the shock sensor system - NII-137. The warhead was characterized by a conical body with a large tip blunting radius. The frame with special equipment is attached to the frame of the hull pressurized bottom and is removed from the hull along with the bottom. The RA3 warhead has a more resistant heat-protective coating on the outside of the hull and, to ensure the functionality of special equipment, an additional heat-protective coating in the form of a layer of foam on the inner shell of the hull. The automation devices were located on a round plate reinforced with ribs. The plate was made of Amg6 alloy and weighed 12 kg. The weight of the bottom with the instrument panel and instruments attached was almost 100 kg. Tests of the warhead were carried out from March 1962 to March 1963. After their completion, the developers of the charge proposed increasing its power through the use of tritium. After carrying out the necessary tests, this modification of the warhead was adopted for service in 1963.  
Charge power - 1 Mt  
Charge weight - 400 kg  
RA3 ("er-a-tri") - 4K-55 SLBM warhead with 4G-55 body (1963)  
RA3G ("er-a-tri-ge") - the warhead of a 4K-55 SLBM with a 4G-55 hull and, probably, with the Gudron system. Testing of the new warhead was carried out in 1966 (see "Status" below).



RA3 warhead of the R-21/4K-55 missile (<https://missilery.info/>)

**D-4M / R-21M** - in 1977-1979. Work has been carried out to modernize the complex to the D-4M level in order to extend the service life - the missiles of the complex use new generation nuclear weapons unified with the missiles of the D-5U and D-5M complexes ( *source - Russian Nuclear Center* ). Ammunition developed by VNIITF, chief designer - O.N. Tikhane. A thermonuclear charge developed by KB-11 (VNIIEF) with a power increased by 33% compared to the SLBM charge of the D-5 complex (i.e. 1.3 Mt?). The automation system is based on the use of two atmospheric sensors for non-contact detonation. Reducing the mass of the charge and automation made it possible to obtain ammunition of smaller mass with an increase in the range of the missile. The warranty service life and the period that the missile remains on the SSBN/SSBN in combat-ready condition have been increased. Serial production - instrument-making plant (Trekhgorny).

When using new ammunition on D-4 missiles, it was necessary to carry out calculations based on 4 parameters. Without computer technology to perform calculations, a calculation device was developed, which significantly reduced the time for preparing data for using ammunition.

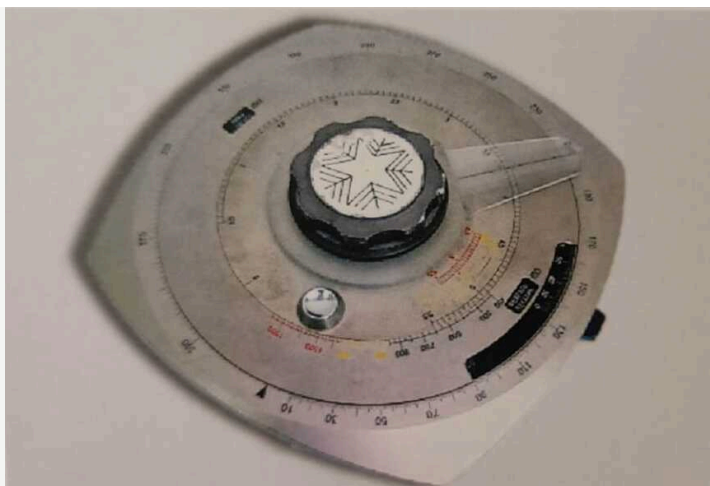




Monoblock unified ammunition of the D-4M, D-5U and D-5M complexes (2015, <https://rocket-history.livejournal.com/>)



Monoblock unified ammunition of the D-4M, D-5U and D-5M complexes (photo - GRC named after Makeyev)

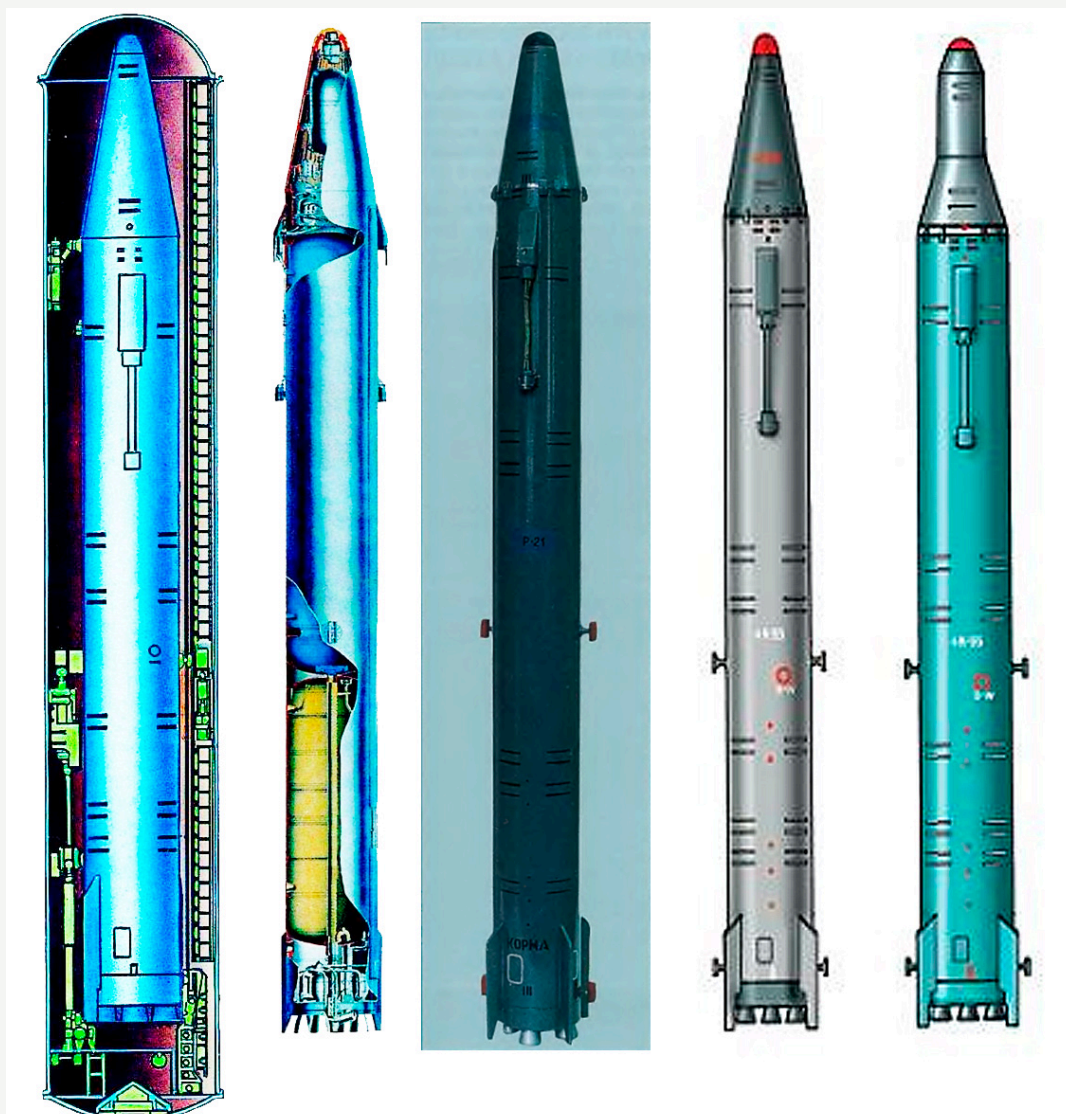


Device for calculating the tuning parameters of the R-21M missile warhead (photo - GRC named after Makeyev)

**Modifications :**

**Complex D-4, missile R-21 / 4K-55** - the basic version of the SLBM, adopted for service in 1963.

**Complex D-4M, missile R-21M / 4K-55M** - modernization of the missile with the installation of a single missile complex D-5U and D-5M unified nuclear charge (the complex was created in 1979 and put into service in 1981). The resolution of the CPSU Central Committee and the USSR Council of Ministers on the development of the D-4M complex with the R-21M missile in order to extend the service life of missiles by replacing combat equipment was adopted on August 30, 1977.

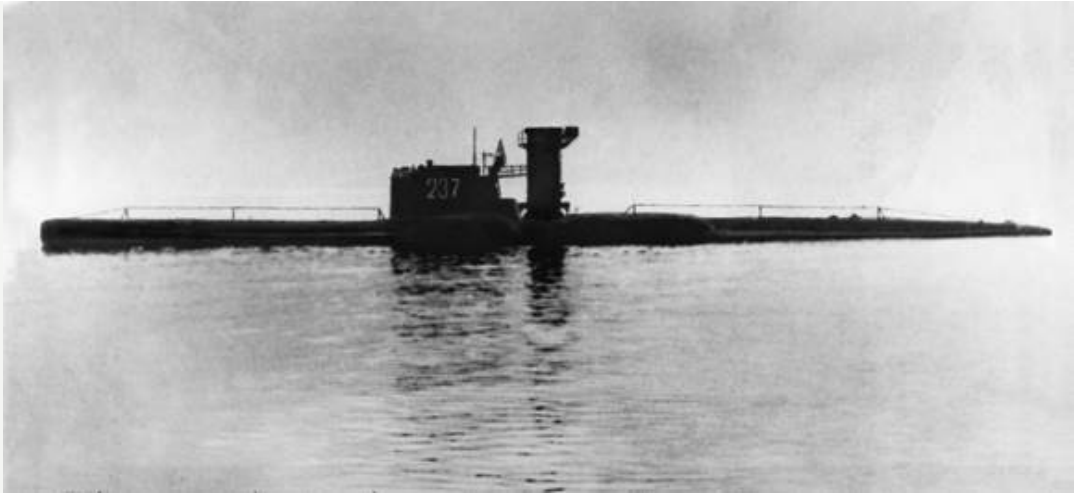


Collage with R-21 missiles. From left to right: silo launcher and R-21 missile, section of the R-21 missile, photo of the R-21 missile, drawings of the R-21 and R-21M missiles

**Carriers :**

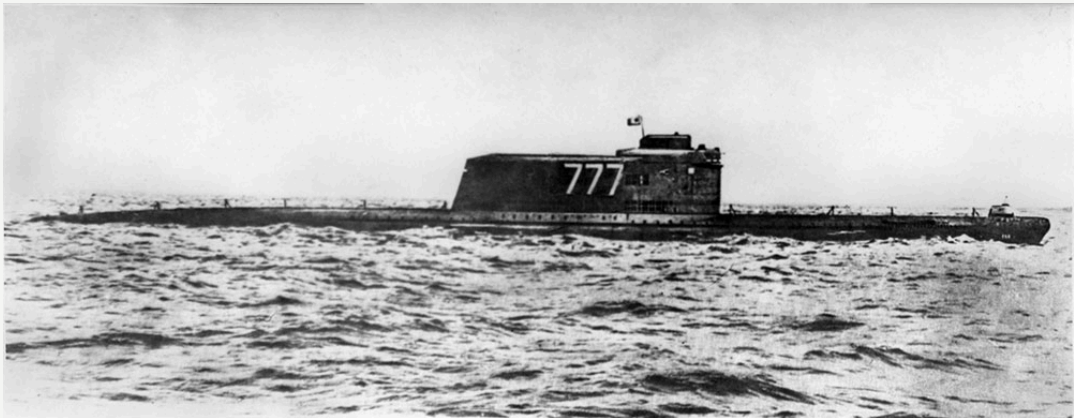
**PLRB pr.613-D4** - experimental PLRB S-229 with one launcher for launching prototypes of the R-21 (K1.1) missile.





PLRB S-229 pr.614D4 ( <http://www.malachite-spb.ru/> )

**SSBN pr.629B / 629A-1 - GOLF-II** (in some sources) - experimental SSBN K-142 converted from SSBN pr.629 for flight testing of the R-21 SLBM.

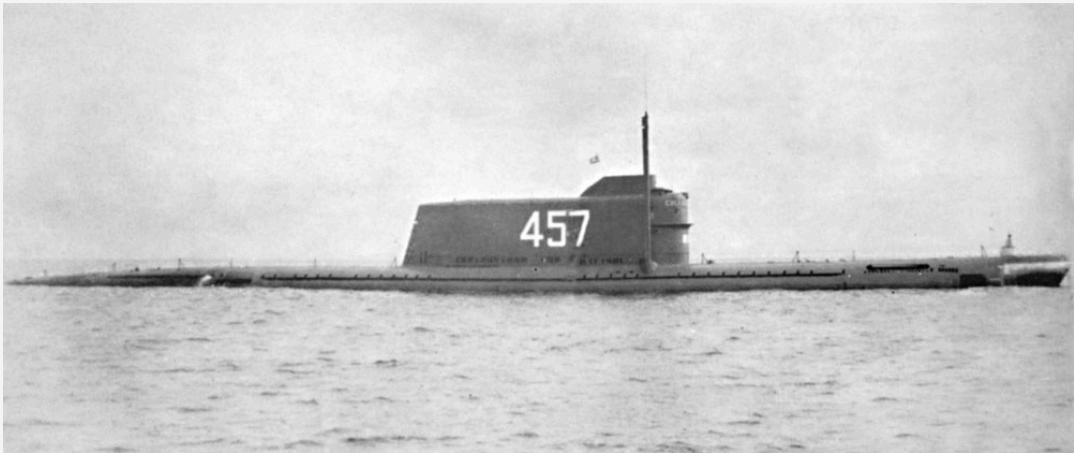


PLRB K-142 pr.629B / 629A-1 during testing, 1962 ( <http://www.malachite-spb.ru/> )

**SSBN pr.629A - GOLF-II** (3 missiles each) - standard carrier of the R-21 SLBM.

Receipt of SSBN pr.629A into the Navy:

Year	Total in the Navy	Admission
1966	1	1
1967	4	3
1968	8	4
1969	9	1
1970	9	
1971	12	3
1972	14	2



PLRB K-91 pr.629A, 1967 ( <http://www.malachite-spb.ru/> )

**SSBN pr.658M - HOTEL-II** (3 missiles each) - standard carrier of the R-21 SLBM. In total, 7 SSBNs were modernized according to Project 658M.

PLRB K-19 pr.658, 1960 (<https://russianships.info/>)

**Status :** USSR

- 1966 February - test launch of a missile with a RA3G warhead over the Halmer-Yu field near Vorkuta from the White Sea (possibly the launch was carried out from the K-19 SSBN pr.658M) - during the launch it was not possible to take all telemetry readings and the product needed modification. Testing of the RA3G product with similar launches was completed later.

**Sources :**

R-21 submarine-launched ballistic missile. // Rocketry. <https://missilery.info/>  
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